

Analysis of Wastewater Treatment using Corncob-Activated Charcoal

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ABSTRACT: Test was conducted to determine some physicochemical and microbiological parameters from samples of effluent collected from industrial and domestic sources. Corncob which till now is an agricultural waste in maize cultivation was used as an adsorbent. It is therefore a cost-effective method. These are carbon-based materials produced by carbonization and activation of Corncob. Among the parameters determined included: Chemical Oxygen (COD), Phosphate (PO_4^{3-}), Nitrate (NO_3^-), Dissolve Oxygen (DO), Iron (Fe), Cadmium (Cd), pH, TA, Total Dissolved Oxygen (TDS), Total Suspended Solids (TSS), Total Heterotrophic Bacteria (THBC), Total Fungi Count (TFC), coli form and others. Results indicated that the effluent need further treatment as the treated samples were still not good for domestic use as some of the values were not within the permissible limits set by World Health Organization (WHO) and other regulatory agencies. However, the use of Corncob which hitherto is an agricultural waste for wastewater treatment is an improvement in water treatment.

KEYWORDS: Wastewater, Corncob, Activated carbon, Microbial, Physiochemical

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INTRODUCTION

Water is an indispensable natural resource essential for the existence of man and the ecological system. Though water is abundantly available in the universe, only 3% of it is fresh water. Approximately, 5% of the fresh water, equivalent to 0.15% of the entire global waters is readily accessible for beneficial purposes [1]. In addition, water serves as an important resource for proper running of industries [2], with a majority ending up as industrial wastewater [3]. In the last few decades, anthropogenic activities coupled with rapid urbanization and industrialization has brought about ecological pressure on aquatic environment which directly or indirectly affects human health. The aquatic ecosystem often gives a reflection of extent of environmental degradation from various anthropogenic activities [4]. Water pollution plays a role in the occurrence of global 'water crisis', by reducing the quantity of freshwater resources available to man as well as the ecosystems. Shortage of freshwater is presently occurring in developing nations such as India, China and many African countries, as well as some developed countries [5]. Globally, 2.1 billion people are deprived of accessibility to clean water and about 4.5 billion

have no access to adequate sanitation [6]. A recent UN report indicates that by 2025, two-thirds of the population of the world could face water stress. The scarcity of water could be in the form of physical scarcity, where water availability is limited and demands are not met, or it could be in the form of economic scarcity, where although water is available, there are no means/ infrastructure to provide water of required quantity and quality [3]. Industrial wastewater released into the water bodies is one of major sources of environmental pollution [7]. The discharge of wastes into the water bodies by man had brought about modification of the environmental water quality, hence making substantial quantities of water unsuitable for various uses [5]. Compromise in the quality of the environment as a result of effluent discharge from the industrial sectors has become an environmental issue for many countries especially developing nations like Nigeria [8]. In the past century, there has been rapid industrial development. This has led to an increase in the complexity of toxic effluents [9]. Release of this industrial wastewater into the environment creates a remarkable impact on the receiving water bodies. This is especially

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true for chemical and allied process industries like the paint industry [3].

The numerous chemicals used for the production of paint are responsible for the high concentrations of organic compounds, suspended solids, coloured materials and hazardous pollutants like heavy metals in the generated wastewater [10]. Some components of these wastes contain hazardous chemical elements which when discharged into the environment may penetrate and leach into the subsurface environment and subsequently settle in the soil and sediment of water bodies [11]. Heavy metals are known to be persistent and can become bioavailable for uptake by other aquatic organisms under favorable conditions. Health challenges like genetic mutation, deformation, cancer, kidney problems etc., have been linked to pollution by heavy metals [12]. Non-restricted disposal of several tonnes of effluents into the lagoon, rivers and streams had become a treat to the aquatic environment. Olaniyi [11] revealed that discharges of untreated or partially treated wastes composed of algal nutrients, non-decomposable organics, heavy metals and other toxicants will result in compromise in quality of the receiving water bodies. The released wastewater gets distributed in the soil, destroying some microfauna, hence hindering the biodiversity of microbial organisms in the soil [7].

Treatment of wastewater prior to discharge into the environment is therefore essential to prevent pollution [11]. This has over time shown to be the best solution to the challenge of using unwholesome water. Researchers have also proven the efficacy of activated carbon as one of the best adsorbents for heavy metal uptake from wastewater, among other adsorbents. It is not only thought to be highly successful, but also simple to use and affordable [13]. Because of its normal abundance, reusability, and cost-effectiveness, activated carbon has shown a promising future [14]. This work is aimed at preparing activated carbon from Corn cob as an adsorbent to limit the spread of contaminants with wastewater using effective and efficient low-cost material. This material hitherto has been an agricultural waste, but now is being utilized for wealth creation.

2. MATERIALS AND METHODS

The domestic wastewater used for the analysis was collected from Waterside River,

Aba and industrial wastewater was collected from 7up Bottling Company, Aba, Abia State. Dried corn was purchased from Ubani market, Umuahia, Abia State.

2.1 Carbonization and Activation of Activated Charcoal

Corn cob was gathered from Ubani market in Abia State. The Corn cobs were cleaned thoroughly and dried in the oven at 70°C for 3 h in order to remove the moisture content. Then; the dried corn cobs were crushed, ground and sieved by 35µm mesh screen. 100 g of ground corn cobs were placed in a pre weighed crucible and carbonized in a muffle furnace at 500°C for 10 minutes. The carbonized corn cob was ground into powder and sieved by 200µm mesh screen. The powder carbonized corn cob was stored in an airtight container.

Activation was performed according to a modified method [15]. The carbonized corn cob was impregnated with 20% zinc (II) chloride (ZnCl₂) followed by heating in absence of air. The resulting mixture was charged into the furnace and heated in inert atmosphere for 60 minutes to a final temperature of 800°C. Cold water was used to quench the activated carbon produced, and this further dried for 60 minutes at 110°C. After the chemical activation, the activated carbon was rinsed thoroughly. Washing was used to remove the remaining zinc chloride and ash in the carbon. This was accomplished by washing with distilled water. The activated carbon was then drained and spread on a tray at room temperature. The activated carbon was dried in an oven at a temperature of 110°C for 3 h. The activated carbon produced was crushed to size of 100µm mesh. This provides the activated carbon with a larger surface area required for gas or liquid adsorption. Activated carbon with smaller particle size adsorbs better than larger particles. This was the final process required to develop activated carbon from Corn cob after which it was packaged into sealable air-tight plastic bag.

2.2 Physicochemical Properties Determination

Physicochemical treatment processes are necessary process in determining the integrity of water.

The Physicochemical Parameters considered are pH, Total Alkalinity, electrical conductivity, turbidity, TDS, Acidity, Total Hardness, TSS,

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dissolved oxygen, BOD, COD, nitrate, phosphate, Cadmium, Iron, Zinc and chloride. They were analyzed according to methods described by APHA [16].

2.2.1 Determination of pH:

The pH of the water samples was determined using the Hanna microprocessor pH meter. It was standardized with a buffer solution of pH range of 4-9.

2.2.2 Determination of conductivity:

This was done using a Jenway conductivity meter (4510 model). The probe was dipped into the container of the samples until a stable reading was obtained and recorded.

2.2.3 Determination of Acidity:

Following the procedure of APHA [16] acidity was determined by titration. 50mL of the sample was pipetted into a clean 250mL conical flask. Two drops of phenolphthalein indicator were then added and the solution titrated against a standard 0.01M NaOH solution to a pink end-point.

$$\text{Acidity (mg/L)} = \frac{V \times M \times 100000}{\text{mL of Sample used}} \quad (1)$$

where: V = volume of NaOH used; M = molarity of NaOH used.

2.2.4 Total Dissolved Solids (TDS):

Total dissolved solids were determined with a TDS meter. The electrode was rinsed with deionized water followed by the water sample. The rinsed electrode was allowed to stabilize in the sample for 1 min after which the TDS value was read directly in mg/L.

2.2.5 Chloride Determination:

This was achieved using method prescribed by APHA [16]. Transfer 25 ml of water sample to a 150 ml of conical flask. Add 0.01N H₂SO₄ with methyl orange to neutralize the amount of carbonate and bicarbonate and provide 1 ml in excess. Add 5-6 drops of potassium chromate indicator making it dark yellow. Titrate the contents against 0.02N AgNO₃ solution with continuous stirring till the first brick red tinge appears. Note the volume of the AgNO₃ required (ml.) Run a blank of 25 ml of distilled water and subtract from the titre value to avoid error due to any impurity of chemicals. Determine the normality of AgNO₃ by standardizing it against NaCl solution.

$$\text{Chloride (mg/L)} = \frac{(V-B) \times N \times 35.45 \times 1000}{\text{sample (ml)}} \quad (2)$$

Where: N = Calculated normality of AgNO₃,
B = Blank Titre value

2.2.6 Nitrate:

Nitrate was determined by the spectrophotometric sodium salicylate method. Standard solutions of potassium nitrate were prepared (0 to 5 mg/L) and 10 ml of each standard solution was mixed with 1 ml of sodium salicylate solution, 2ml of concentrated Sulphuric acid and allowed to stand for 15 min. A 15 ml volume of distilled water and 15 ml of sodium titrate solution were added to each sample and absorbance of the yellow colour developed was read at 420 nm. A calibration curve was plotted with the absorbance values of the standard and the concentration (mg/L) of nitrate in the samples was extrapolated from the standard curve.

2.2.7 Phosphate:

Phosphate was determined by the molybdate spectrophotometric method described by APHA [16]. Standard solutions of KH₂PO₄ were prepared to contain 0, 2, 4, 6, 8 and 10 mg/L of phosphate. A volume (15 ml) of each water sample and the standard solution in 50 ml volumetric flask was mixed with 1 ml of ammonium molybdate reagent, 3 drops of stannous chloride reagent and diluted to 50 ml with distilled water. Absorbance values of the water samples and standard solutions were read at 650 nm using spectronic 21 spectrophotometer. A standard curve was prepared with the absorbance values and the concentration of phosphate in the sample was extrapolated from the standard curve.

2.2.8 Determination of dissolved oxygen:

This was done following the azide modification of the iodometric method as described by APHA [16]. Standard BOD bottles were filled with abattoir effluents completely. MnSO₄ (2ml) and 2ml of alkaline iodide-azide were added onto the surface of the samples in the BOD bottles and allowed to stand for 5 minutes. A Known quantity, 1ml of concentrated sulphuric acid solution was added and the mixture left to stand for another 5 minutes. A volume, 200ml of these clear solutions were collected in different conical flasks and 2 drops of starch indicators were added to each flask, which gives a deep blue coloration.

Subsequently, the mixtures were titrated with sodium thiosulphate (0.025N) solution till the colour changed to colourless and the titre values recorded.

2.2.8 Determination of biochemical oxygen demand:

This was done after five days of incubation following the azide modification of the iodometric method as described by APHA [16]. Dilution water was prepared. A desired quantity of the sample was made up to about 1 litre with the dilution water. Careful mixing was done to avoid the formation of bubbles. The mixed dilution was siphoned into two BOD (300 ml) bottles excluding air bubbles. One of the BOD bottle was corked and incubated for five days at 20 °C. To the other BOD bottle, 2 ml of Manganous sulphate (MnSO_4), followed by 2 ml of alkaline-iodide azide were added and bottle corked carefully to exclude air bubbles. The content was mixed thoroughly by shaken and inverting several times and the precipitate allowed settling at the bottom of the sample. After the precipitate had settled, 2 ml concentrated sulphuric acid (H_2SO_4) was added, corked and the bottle inverted several times to dissolved the precipitate, an intense yellow colour was obtained. 100 ml of the solution was taken and titrated with 0.0125M sodium thiosulphate to a pale yellow colour and 1ml starch was added as indicator. The titration was continued to the first disappearance of the blue colour. The above procedure was followed for the incubate samples at the end of the days to determine the difference in DO for the computation of BOD.

$$\text{BOD (mg/L)} = \frac{(D_1 - D_2)}{P} \quad (3)$$

D_1 = DO of diluted sample immediately after preparation, mg/L

D_2 = DO of diluted sample after 5 day incubation at 20 °C, mg/L

P = Decimal volumetric fraction of sample used (1/dilution factor)

2.2.9 Determination of Chemical oxygen demand:

The digestion tubes and caps were washed with 4M sulphuric acid first to prevent contamination. Five milliliter (5ml) of the sample or a diluted aliquot is transferred into a labeled culture tube and 3ml potassium dichromate solution (digestion solution) added.

Seven millilitres (7ml) H_2SO_4 reagent (silver sulphate in sulphuric acid) was added carefully to form an acid layer under the sample digestion layer. The tube was tightly capped, shaken and inverted several times to mix completely. The tubes were placed in a digester at 150°C and reflux for two hours, and then cooled to room temperature. 1-2 drops of ferroin indicator was added and titrated with standard FAS solution until the colour changes from blue-green to reddish brown or wine (endpoint). The procedure was repeated for a blank sample containing the reagents and a volume of deionized water equal to that of the sample.

$$\text{COD (mg/L)} = \frac{(A-B) \times M \times 8000}{V} \quad (4)$$

A = volume of FAS used for blank, ml

B = volume of FAS used for sample, ml

M = molarity of FAS

V = volume of sample

8000 = milliequivalent of oxygen x 1000 ml/l

2.2.10 Iron determination:

This was done as described by APHA [17]. Take 50 mL of mixed sample into a 125 mL conical flask. If this volume is expected to contain more than 200 µg iron use a smaller portion and dilute to 50 mL. Add 2 mL conc HCl 1 mL NH_2OH . HCl solution, a few glass beads and heat to boiling till the volume is reduced to 15-20 mL, cool, and transfer to a 50 mL volumetric flask. Add 10 mL $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ buffer solution and 4 mL phenanthroline solution, dilute to the mark with water. Mix and allow 10-15 min. for colour development. Take photometer readings at 510nm. Read from the calibration curve and calculate the iron content.

$$\text{mgFe/L} = \frac{A \times 50}{\text{mL sample analyzed}} \quad (5)$$

Where: A is the concentration of Iron obtained from the curve

2.2.11 Determination of Zinc:

Zinc content of each sample was determined by the method described by AOAC (2005). Pipet 25 mL of digest into 250-mL erlenmeyer flasks. 15 mL of water, 9-10 mL of pH 10 buffer were added, and 2 drops of Eriochrome Black T was added immediately and titrated against a EDTA until the red solution turns blue. The concentration of zinc was calculated from the formula in equation 6.

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$$Zn(mg) = M_{EDTA} \times (V, mL EDTA) \times (molar\ mass\ Zn) \times 10 \quad (6)$$

ultraviolet-visible (UV-VIS) spectrophotometric method as described by [16]. To 5ml of each samples, 5% cyanidin solution was added to 5ml of the mineral digest, the solution was adjusted to a PH of 5.0 and left to stand for 10 minutes before the absorbance was read at 535nm (Cd).

2.2.13 Determination of Alkalinity:

50mL of the sample was pipetted into a clean 250ml conical flask. Two drops of methyl red indicator were then added and the solution titrated against a standard 0.01M HCl solution to a pink end-point.

Total alkalinity (mg/l) = $[V \times M \times 100,000] / \text{ml of sample used}$

Where V = volume of acid used

M = Molarity of acid used.

2.2.14 Determination of total suspended solids (TSS):

The total suspended solids were easily obtained by simple calculation, i.e.

Total suspended solids = total solid – total dissolved solids.

2.2.15 Determination of Total Hardness:

50 ml of the water to be tested in the graduated cylinder was measured. It was then poured into the casserole 1/2 mL of Hardness Buffer Solution was added into the casserole and stir. Also, 1 scoop of Hardness Indicator Powder was added. If the water turns blue in color, no hardness is present and the hardness is reported as "zero". If the water turns purple or red, hardness is present and the test should be continued. The plastic bottle was squeezed, forcing the Hardness Titrating Solution to fill the burette to just above the zero mark; this allows the excess to drain automatically back

2.2.12 Determination of Cadmium (Cd): This was determined by the Simultaneous into the plastic bottle reservoir. While stirring the sample constantly, the hardness titrating solution was added slowly from the burette to the casserole, until the purple or red color changes to blue. This is the endpoint and the Burette was read.

2.2.16 Determination of turbidity:

Sample was gently agitated. Waited until air bubbles disappear and pour sample into cell and immersed it in an ultrasonic bath for 1 to 2s causing complete bubble release. Turbidity was read directly from instrument display.

2.3 Microbial Analysis

5 grams of the sample was dissolved in 45ml of distilled water. 1ml of the sample suspension was diluted using a tenfold serial dilution inoculating them on a nutrient agar, MacConkey agar and potato dextrose Agar respectively. The dilution used was 10^6 . The organisms inoculated on nutrient agar were incubated for 24hrs at 37°C. The plates were observed for growth after been incubated and were purified and the microbial load counted and calculated. The purified cultures were then transferred onto MacConkey agar (a selective media) and incubated for 24hrs at 37°C. The samples were equally plated on potato dextrose agar (PDA) for isolation of fungi. Thereafter the organisms (bacteria) were characterized biochemically. The fungi isolated were characterized with the microscope and with reference to mycological manuals.

All data obtained from the analysis were subjected to One-way analysis of variance (ANOVA) using Minitab software package version 20. Means were separated using Turkey test to determine the significant difference at 5% probability.

Table 1: Chemical Properties of Wastewater with AC treatment

SAMPLE	Cd mg/l	Fe mg/l	Zn mg/l	BOD mg/l	COD mg/l	DO mg/l	Cl ⁻ pmm	NO ₃ pmm	PO ₄
Untreated Industrial Wastewater	0.45	0.77	0.5	131.95	341.7	14.23	41.635	0.29	0.47
Treated Industrial Wastewater	0.06	0.21	0.2	52.375	97.875	6.2	36.855	0.11	4.06
Untreated Domestic Wastewater	0.215	0.895	0.31	210.64	469.64	16.98	59	0.39	4.04
Treated Domestic Wastewater	0.07	0.25	0.115	19.325	161.06	6.09	38.415	0.18	1.09

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3. RESULTS AND DISCUSSION

The mean values of the chemical properties of effluents and treated wastewater are shown in Table 1. The results revealed some significant changes at $P \leq 0.05$. The values obtained for the determination of Chemical Oxygen Demand (COD) of the domestic wastewater (Untreated) was 469.64 ± 0.04 mg/l before the treatment, but decreased to 161.06 ± 0.06 mg/l after the treatment (treated), while Industrial wastewater samples (Untreated) was 341.7 ± 0.01 before the treatment, it was decreased to 97.88 ± 0.03 after treatment (treated). There was significant different ($P \leq 0.5$) in all the samples. Untreated domestic wastewater was significantly higher when compared to others analyzed. This showed that the effluent was seriously contaminated with organic pollutants, since COD is indirectly used to measure the number of organic compounds in water. The concentrations of COD in all the samples were higher than the WHO limits. High COD concentration observed in the wastewater

might be due to the use of chemicals, which are organic or inorganic that are oxygen demand in nature. Table 2 presents the ANOVA table for the chemical properties of both treated and untreated samples.

The values of Cadmium (Cd) recorded for the effluent before the treatment and after the treatment presented significant different ($P \leq 0.5$) in all the samples. Cadmium is a non-essential metal and produces only significant adverse health effects. The values of Iron (Fe) recorded for the effluent before the treatment is 0.77 and 0.9 mg/l for untreated industrial wastewater and untreated domestic wastewater respectively. The treatment of the effluents resulted in the reduction of the Fe to 0.25 and 0.21 mg/l for treated domestic and industrial wastewater respectively. There was significant different ($P \leq 0.5$) in all the samples. Figure 1 presents the mean values of the chemical properties of the water samples.

Table 2: Analysis of Variance of Chemical properties for AC treatment

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Factor	8	255467	70.12%	255467	31933	7.92	0.000
Error	27	108873	29.88%	108873	4032		
Total	35	364340	100.00%				

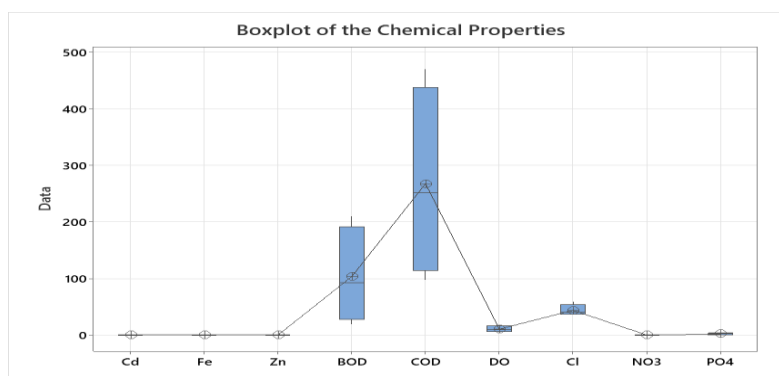


Figure 1: Plot for the means of Chemical properties of the AC treatment

These values contribute to the daily iron source. Iron is important in many biological processes because it is an ideal oxygen carrier and because it can function as a protein-bound redox element. The values recorded for Phosphate (PO_4^{3-}) of the wastewater before the treatment are 4.04 and 0.47 mg/l for untreated domestic wastewater and untreated industrial wastewater respectively. The treatment of the

influent resulted in reduction in value for both treated domestic and industrial wastewater respectively.

Dissolved Oxygen (DO) was also determined with significant different ($P \leq 0.5$) in all the samples. The DO is a measure of the degree of pollution by organic matter, the destruction of organic substances as well as the self-purification ability of the water body. The

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values of DO recorded in this present study are within the limit stated by WHO (100 mg/l). Prior to treatment, the DO level of wastewater from the selected source were significantly higher. Other chemical properties such as BOD, Zinc (Zn), Chloride and Nitrate are also presented significant differences among the samples. The treated samples showed improved qualities than the untreated samples.

Furthermore, the results of evaluation of the physical properties of the effluents are present in Table 3. The pH values of the effluents showed significant difference at $P \leq 0.05$ among the samples. The study showed that the industrial wastewater were more acidic compared to other samples analyzed. The

difference in pH values might be due to the treatment which has resulted to the slightest variation observed. The results of Total Alkalinity (TA) of the effluent ranged from 62.42 to 176.06 mg/l. The highest value was found in untreated industrial wastewater, followed by untreated domestic wastewater, while the least value was found in treated industrial wastewater. The alkalinity values of the sampled wastewater were below the stipulated limits of 100 mg/l by WHO [18]. This again confirmed the slightly acidic nature of effluent analyzed. Table 4 shows the ANOVA presentation of the comparison of the various means obtained in the experiment.

Table 3: Physical Properties of Wastewater with AC treatment

SAMPLE	pH	TA mg/l	TDS mg/l	TSS mg/l	EC $\mu\text{S/cm}$	Turbidity NTU	Acidity	TH ppm
Untreated Industrial Wastewater	4.305	176.06	477.5	18.68	826	42.84	36	62.57
Treated Industrial Wastewater	4.2	70.94	276	11.42	554	15.1	31.56	59.07
Untreated Domestic Wastewater	5.74	96.19	85	17.62	620.0	39.65	22.825	50.275
Treated Domestic Wastewater	7.72	62.42	40	0.215	84.5	12.985	13.965	29.065

Table 4: Analysis of Variance of Chemical properties for AC treatment

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Factor	7	872693	67.28%	872693	124670	7.05	0.000
Error	24	424505	32.72%	424505	17688		
Total	31	1297198	100.00%				

Total Dissolved Solids (TDS) values of the water samples ranged from 477.5 to 40 mg/l. It was found to be decreasing as the treatment was applied. The TDS values were significantly ($P \leq 0.5$) higher in the untreated wastewater samples. There was significant different ($P \leq$

0.5) in all the samples. This increase could be as a result of the presence of dissolved ions of resins, organic and inorganic solvents and additives in the samples. Total dissolved solid is a measure of all dissolved substances in water [19].

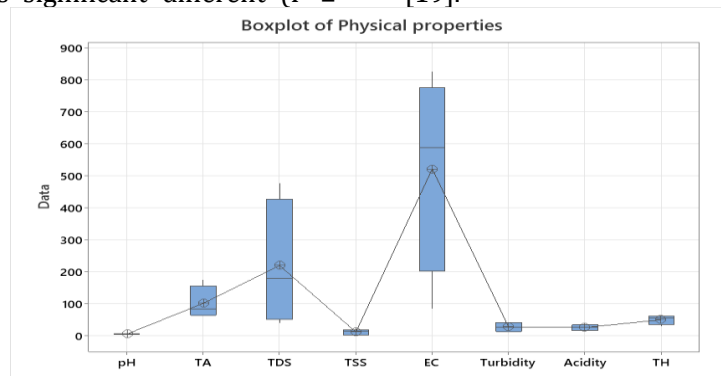


Figure 2: Plot for the means of Physical properties of the AC treatment

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Total Suspended Solids (TSS) content obtained for the samples varied from 0.22 to 18.68mg/l. The highest value occurred in untreated industrial wastewater, while the least value occurred in the treated domestic wastewater. There was significant different ($P \leq 0.5$) in all

the samples. Figure 2 shows the mean values of the respective parameters in a box plot.

The microbial examination of the wastewater sampled revealed different values for total heterotrophic bacteria count, total fungi count and coliform count as shown in Table 5.

Table 5: Microbial load of the Wastewater samples

SAMPLE	THBC (cfu/ml)	TFC (cfu/ml)	Coliform (MPN/100mL)
Untreated Industrial Wastewater	1.01×10^9	2×10^5	33
Treated Industrial Wastewater	1.59×10^7	5×10^3	20
Untreated Domestic Wastewater	2.0×10^7	5×10^4	17
Treated Domestic Wastewater	2.8×10^5	4×10^2	8

The results of the microbial analysis of the wastewater under study showed some relatively very high increased total heterotrophic bacteria count (THBC), total fungi count (TFC) and coliform. The THBC of the treated and untreated wastewater ranged from 1.59×10^7 to 2.0×10^8 cfu/ml. TFC ranged from 2×10^5 to 5×10^4 cfu/ml while Coliform ranged from 8 to 33mpn/100ml. The untreated industrial wastewater had the highest count on THBC, TFC and Coliform while treated domestic wastewater had the lowest counts on both. It was observed that all the treated wastewater was relatively low when compared to other ones.

However, after the treatment the mean values were still above the limits (10cfu/100ml and $10 < \text{cfu}/100\text{ml}$) stipulated by Nigerian Standard for Drinking water quality [20] and World Health Organization [18] respectively. Seven genera of microorganism were identified in all the wastewater; however there was no *Streptococcus* spp observed on both treated and untreated domestic wastewater. The microorganisms isolated were: *Staphylococcus* spp, *E.coli*, *Streptococcus* spp, *Pseudomonas* spp, *Bacillus* spp, *Proteus* spp and *Klebsiella* spp. These samples analysed were not fit for consumption without further purification.

Table 6: Bacteria isolated from the effluent samples

SAMPLE	Staphylococcus spp	E.coli	Streptococcus Spp	Pseudomonas Spp	Bacillus spp	Proteus Spp	Klebsiella spp
Untreated Industrial Wastewater	+	+	+	+	+	+	+
Treated Industrial Wastewater	+	+	+	+	+	+	+
Untreated Domestic Wastewater	+	+	-	+	+	+	+
Treated Domestic Wastewater	+	+	-	+	+	+	+

4. CONCLUSION

This work is aimed at preparing activated carbon as an adsorbent to limit the spread of contaminants with wastewater using effective and efficient low-cost material. Test was

conducted to determine some physicochemical and microbiological parameters from samples of effluent collected from industrial and domestic sources. Activated Corn cobs charcoal which till now was an agricultural waste in maize cultivation was used as the adsorbent.

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Among the parameters determined included: COD, PO₄³⁻, NO₃, DO, Fe, Cd, pH, TA, TDS, TSS, THBC, TFC, coliform and others. The use of

Corncob which hitherto was an agricultural waste for wastewater treatment is an improvement in water treatment.

Table 7: Physiochemical parameters/indicators for water quality

Parameters	Standards		
	WHO	NDWQS	NIS
COD (Chemical Oxygen Demand)	5.0	3.0	3.0
BOD (Biochemical Oxygen Demand)	5.0-10	6.0	6.0
DO (Dissolved Oxygen) (mg/L)	5.0-7.0	5.0	4.0-6.0
pH	6.5-8.5	6.5-9	6.0-9.2
EC (Electrical Conductivity) (µS/cm)	750	1000	1000
TDS (Total Dissolved Solids) (mg/L)	500-1000	500-1000	500
Acidity			
TH (Total Hardness) (ppm)	300	200	150
Cl (Chlorides) (ppm)	200-600	250	350
NO ₃ (Nitrates) (ppm)	45	50	50
PO ₄ (Phosphate)	0.4-2.0		0.3
Zn (Zinc)	0.2	3	
Fe (Iron)	0.3	0.3	0.3
Pb (Lead)	0.01	0.01	0.01
Cd (Cadmium)	0.003-0.01	0.003	
Temperature (°C)	25-28		

WHO-World Health Organization; NIS-Nigeria Industrial Standards; NDWQS-National Standard for Drinking Water Quality. Source: World Health Organization (2003); Ministry of Health Malaysia (2007) *NDWQS: National Drinking Water Quality Standard*; Nigerian Industrial Standard (2015).

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